PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P26452PC00	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/ZA 03/00181	International filing date *(day/month/year)* 05.12.2003	Priority date *(day/month/year)* 02.04.2003
International Patent Classification (IPC) or both national classification and IPC H04B10/22		
Applicant RAND AFRIKAANS UNIVERSITY et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
29.10.2004	06.06.2005
Name and mailing address of the International preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Petitit, N Telephone No. +49 89 2399-7715

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/ZA 03/00181

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-11	as originally filed

Claims, Numbers

4-17	filed with telefax on 05.04.2005
1-3	filed with telefax on 27.05.2005

Drawings, Sheets

1/5-5/5	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-17
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-17
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-17
	No:	Claims	

2. Citations and explanations

   see separate sheet

1. Technical field

The present application relates to a method and a system for monitoring a variable relating to a rotating element using an optical signal (Independent system claim 1 and independent method claim 15).

2. State of the art

The closest prior art found are documents D1 (US4746791) and D3 (US5182953), which disclose a sensor for monitoring the position or movement of a rotating element.

The sensor comprises an optical modulator, while the rotating element comprises a magnetic part (permanent magnet in D1 and ferrous elements in D3).

An optical signal is sent to the modulator, which modulates the signal according to the position and motion of the magnetic part (therefore of the element to monitor) and reflects the modulated optical signal for analysis.

3. Novelty

None of the prior art documents cited in the International Search Report discloses the combination of features of claims 1 and 15.

In particular, documents D1 and D3 do not show the feature of claims 1 and 15 according to which the modulator (optical transducer) is mountable on the rotating element.

Instead in documents D1 and D3, the modulator is explicitely part of the fixed sensor and mounting the modulator on the rotating element would remove its modulating capacity.

The subject-matter of claims 1 and 15 is therefore new (Article 33(2) PCT).

4. Problem to be solved

The technical problem to be solved by the differentiating feature of the claims 1 and 15 over the prior art can be formulated as:

How to monitor temperature variations in the rotating element.

5. Inventive step

Document D3 provides a system and method for monitoring the temperature of the rotating element using the polarization of the optical signal.

However, there is no hint in the available prior art for placing the modulator in direct contact with the rotating element for the modulator to be influenced by the temperature of the rotator thus to monitor the temperature variations of the rotating element accurately.

The subject-matter of claims 1 and 15 therefore involves an inventive step (Article 33(3) PCT).

6. Dependent claims

Claims 2-14 and 16-17 being dependent on claims 1 and 15, their subject-matter is new and involves an inventive step (Articles 33(2) and 33(3) PCT).

CLAIMS

1. A system for monitoring a variable relating to a rotating member, the system comprising:

   - a source of optical energy for emitting optical energy and which source is mountable at a stationary station;

   - at least one optical transducer mountable on the rotating member and which transducer in use modulates optical energy received from the source in accordance with changes in the variable relating to the member; and

   - an optical transmission system mountable between the source and the member for transmitting through free space emitted optical energy from the stationary station to the rotating member, and the modulated optical energy from the rotating member to the stationary station.

2. A system as claimed in claim 1 wherein the optical source comprises one of a broadband optical source and a frequency sweeping narrowband source, coupled to a first length of optical fibre.

3. A system as claimed in claim 2 wherein the optical transmission system comprises a first lens and a second lens, the first lens being mountable on the stationary station in substantial alignment with the second lens, which is mountable on the member.

4. A system as claimed in claim 3 wherein the first lens and the second lens comprise a pair of graded-index lenses.

5. A system as claimed in any one of claims 2 to 4 wherein the transducer comprises a second length of optical fibre mountable on the rotating member and an optical energy modulating arrangement connected to the second length of optical fibre.

6. A system as claimed in claim 5 wherein the modulating arrangement comprises a first optical energy reflective element and a second optical energy reflective element.

7. A system as claimed in claim 6 wherein the first and second elements comprise a first and a second Bragg grating respectively having respective center frequencies which are spaced in wavelength.

8. A system as claimed in claim 6 or claim 7 wherein the first and second elements are mounted on the member in spaced relationship relative to one another.

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9. A system as claimed in claim 6 or claim 7 wherein the first and second elements are mounted on the member in at least partially overlapping relationship with one another.

10. A system as claimed in claim 8 or claim 9 wherein the first and second elements are mounted on the member at ninety degrees relative to one another.

11. A system as claimed in any one of claims 8 to 10 wherein each of the first element and the second element extends at an angle of forty-five degrees to a longitudinal axis of the rotating member.

12. A system as claimed in any one of claims 3 to 10 comprising means for separating optical energy emitted by the source and modulated energy propagating from the transducer.

13. A system as claimed in claim 12 wherein said means comprises an optical circulator having a first port connected to the source, a second port connected to the first lens and an output.

14. A system as claimed in claim 13 wherein the output of the circulator is connected to means sensitive to modulation of the optical energy.

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15. A method of monitoring a variable relating to a rotating member, the method comprising the steps of:

- transmitting from a stationary station optical energy through free space towards the member;
- receiving the transmitted energy on the member and causing the energy to be modulated in accordance with the variable to be monitored;
- transmitting from the member and via free space the modulated energy to the stationary station; and
- receiving and analyzing said modulated energy at the stationary station.

16. A method as claimed in claim 15 wherein during modulation of the energy, first and second optical energy reflective elements are used on the rotating member and which elements reflect optical energy of first and second wavelengths respectively and wherein a change in an average value of said wavelengths is associated with a first variable relating to the rotating member and a change in a difference between said wavelengths is associated with a second variable relating to the rotating member.

17. A method as claimed in claim 16 wherein the first variable is temperature on the member and the second variable is torque applied to the member.

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